

Forest-based betel leaf and betel nut farming of the Khasia indigenous People in Bangladesh: approach to biodiversity conservation in Lawachara National Park (LNP)

Md. Jahirul Islam • Tapan Kumar Nath

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Abstract: An exploratory survey was conducted among the Khasia living in Lawachara National Park (LNP) to investigate their dependency on the protected area (PA) for livelihoods, betel leaf hill farming, traditional forest conservation and perceptions of the PA. Field data were collected by interviewing 48 household heads from two villages (punjis) located inside the LNP and visiting their farms. The economy of the Khasia was forest-based. They were largely dependent on betel leaf hill farming in LNP and nearly 71% of their mean annual income was derived from this irrespective of farmer category. On average, about 14% of the incomes of the poorer farmers came from forest produce followed by 10% and 6% for medium and rich farmers respectively. Hills and forests were the foundations of their lives and livelihoods, and LNP was the life-blood of Khasia survival. As a sustainable production system, this farming practice plays a vital role in conserving biodiversity in LNP and might be replicated elsewhere.

Keywords: Bangladesh, indigenous people, Khasia, livelihoods, betel leaf farming, protected area management

Introduction

Bangladesh is a land of enormous scenic beauty with evergreen hills, luxuriant tropical rain forests, and rich cultural heritage and ethnic diversity. For centuries, it has been a dwelling place of indigenous communities estimated by Khaleque (1998) to num-

ber 27, with 3 million people (IWGIA 2012). Indigenous villagers mainly occupied the hilly eastern and south-eastern parts of the country. The Khasia are one of the major forest-dwelling communities living in the hill forests of north-eastern Bangladesh. About 500 years ago they settled in the hills and low hills (tillas) of northeastern Bangladesh. Hills and forests are the foundation of their lives and livelihoods. The 1991 census estimated the population of Khasias in Bangladesh at 12,300 (BBS 1991). At that time, the Bangladesh Khasia Society estimated the number to be approximately 30,000 while Joshua Project (2011) reported it as 81,000.

Because they often support high levels of biodiversity and also have potential as eco-tourism destinations with many aesthetic and cultural values, including scenic beauty and ethnic diversity, PAs are the most widely accepted mechanism for conserving forest biodiversity. In some PAs, managers prevent entry of local people, following the view that human activities are incompatible with ecosystem conservation (Wells and McShane 2004). But designation of an area as a “national park”, “wildlife sanctuary” or “reserve forest” failed to effectively conserve biodiversity in Bangladesh in absence of alternative livelihood strategies for the people heavily dependent on products from these areas. This was especially true when restrictions were imposed on their long-held traditions of forest use. In recent years, an emerging model is based on community-based forest conservation and biodiversity protection in exchange for provision of tangible benefits from sustainable utilization of forests (RECOFTC 1995, Nath and Inoue 2009). Environmentalists and national conservation authorities worldwide have begun to emphasize the importance of local participation in decision-making for the management of PAs (Agrawal and Gibson 1999). In Bangladesh, the need for involvement of ethnic communities in development programs, particularly in those designed for the areas where these people live, has been recognized by the policy planners (Khaleque 1998). The Bangladesh Forest Department (FD) had taken a step to involve Khasia people in management of Lawachara National Park (LNP) though there were other indigenous communities namely Manipuri and Tripura who migrated there few decades ago. The

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Md. Jahirul Islam (✉)
Bangladesh Planning Commission, Dhaka, Bangladesh
E-mail: mdjahirul.bd@gmail.com; ketty2911@yahoo.com

Tapan Kumar Nath
Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong-4331, Bangladesh

Corresponding editor: Yu Lei

Khasia communities have been living for many decades in the area now designated as LNP, while the other two communities occupy the plain land beyond the LNP periphery. On their own land, the Tripura mainly cultivate pineapples and lemons while the Manipuri cultivate paddy. Since the Khasia have for many years practiced forest-based betel leaf and betel nut farming in the hill forest, the FD made provision for them in the forest management program.

The forests of West Bhanugach Reserve Forest (RF) were designated as RFs during the early nineteenth century (NSP 2006). A large part of this RF has recently been included with the boundary of LNP. Before reservation, many forest areas were cleared for shifting cultivation (*jhumming*) or “slash and burn” agriculture and common grazing grounds for the entire neighborhood. After reservation, *jhumming* and grazing were greatly reduced and secondary vegetation developed. Though the main objective of reservation was to protect the forests, the condition of the forests did not improve due to illegal removal of forest products and the continuation of *jhumming* (Nath et al. 2003). Presently, the park supports small patches of virgin forest surrounded almost entirely by regrowth of secondary forest. The FD started a plantation program in 1922 with the object of restoring the previous forest cover (Anon 1970). But due to the shortage of labor little progress was achieved. So the FD introduced the forest village concept in 1952–1953 under an agreement between the FD and representatives of the Khasia community (NSP 2006). About 1.01 ha for the betel leaf farm and 0.2 ha for the homestead, a total of 1.21 ha of forestland was allotted for 99 years on a biennial renewal basis to each family for house construction and betel leaf farming as an alternative livelihood. In exchange, villagers provided labor required for FD activities including nursery operation, tree plantation, and weeding and protection of forests from pilferage. Participants in the land lease program were selected from those Khasia who were most disadvantaged, obedient, and industrious, and who had good knowledge of forest management and strong liaison with Forest Department officials. The condition of land lease was that they would enjoy inheritable land rights but could not sell or even shift from their allotted lands. Due to the FD’s initiative, the plantation program gained momentum during 1955–60 (Drigo et al. 1988). Rich Khasia people were not prohibited from owning their own land outside the forest reserves.

The main occupation of the Khasia people was agriculture: they practiced market-oriented betel leaf (*Piper betle*) and betel nut (*Areca catechu*) farming on forest lands since 1952 (Alam and Mohiuddin 1995). A member of the family of Piperaceae, betel leaf is a perennial dioecious climber that creeps up support trees using its adventitious roots. The vine grows best in moist, tropical forest conditions with cool shade, high humidity and abundant soil moisture (Bendre and Kumar 1980). Betel nut is a large evergreen palm with a tall straight bole and attains height of 24 m and girth of 15.5 cm (Khan and Alam 1996). It provides income to farmers through sale of fruits. Other important products of Khasia are lemon, pineapple, and jackfruits. Betel leaf (locally known as *Khasia pann*) is very popular among the people of Bangladesh, India and Pakistan, and is usually chewed

with slices of betel nut and lime. Both betel leaf and betel nut have medicinal value and are widely used in social festivals for hospitality. It has a huge domestic market and was exported in small quantities to India prior to 1954 (Rashid 1991). Now the market has been expanded to other parts of the world and exports reach the Middle East, the United Kingdom, Pakistan and some countries of Africa (Pthmai et al. 2006). Many people of Bangladesh live in the U.K. and they are very much fond of *Khasia pann*. Good quality leaves from their farms are exported to the UK.

Studies have been conducted on the hill-centric livelihoods and farming systems of forest dwelling indigenous communities in Bangladesh. Khaleque (1983) studied the wet cultivation and property changes of the *Garo* ethnic people in Madhupur Barind. Uddin and Saha (1994) studied trends and constraints of farming systems in the Chittagong Hill Tracts (CHTs). Millat-e-Mustafa et al. (1999 and 2002) and Siddiqui et al. (2002) explored the indigenous farming systems and socio-economic status of the *Marma* tribe in the CHTs. Alam and Mohiuddin (1995) studied the conservation of tree diversity through betel leaf cultivation by Khasia people in Sylhet district. There has been little research on the status of the government initiative to involve Khasia people in biodiversity conservation at LNP by allowing cultivation of betel leaf and betel nut as alternative livelihoods. The aim of this study was, therefore, to explore the dependency of the Khasia communities on LNP. The objectives of the study were to describe their hill farming practices and mechanisms for traditional forest conservation, document forest types and vegetation, and evaluate patterns of forest resource use villager perceptions of the PA. The study output might have policy implications because local dependency should be properly accounted for in protected area management (Masozera and Alavalapati 2004; Sunderlin et al. 2005, Nath and Inoue 2009). The introduction of participatory management in PAs for nature conservation is relatively new in Bangladesh. It needs to be examined whether bringing a group of people under alternative income generating activities, and clearly defining the rights and responsibilities of the people in PAs can change in the forest resource collection patterns and the attitudes and dependency of people on PAs. Results of our work might stimulate policy makers and PA managers of Bangladesh to discover an optimal, acceptable and effective model for the sustainable management of PAs. For PA managers, detailed knowledge of the people whose lives are affected by PA establishment and management can be as important as information about the flora and fauna to be conserved (Veech 2003).

Materials and methods

Study area

Lawachara National Park (IUCN category II: a protected area managed mainly for ecosystem conservation and recreation (IUCN 1994)), one of eighteen protected areas in Bangladesh was established in 1996 and encompasses 1,205 ha. LNP is situ-

ated in Maulvibazar District nearly 160 km northeast of the capital city, Dhaka, and approximately 60 km south of Sylhet city. The PA is at latitude 24°30'–24°32' N and longitude 91°37'–91°39' E. LNP topography is undulating with slopes and hillocks (*tillas*), ranging from 10–15 m in height. The soils are brown, sandy clay loams of Pliocene origin (Hussain et al. 1989). The climate of the park is generally warm and humid but the weather is cool and pleasant during winter. The temperature ranges on average from a minimum of 26.8°C in February to a maximum of 36.1°C in June. The humidity is high in the Park throughout the year with the monthly average ranging from 74% in March to 89% in July and mean annual rainfall is 4000 mm. (NSP 2006). This type of climatic and edaphic condition is favorable for betel leaf and betel nut cultivation.

The Manu River flows on the north of the park and the Dholoi River on the east. Many streams flow through the park. The park is bordered by tea gardens on the southeast, south and east sides, and coffee plantations on the west side. The forest type is semi-evergreen and mixed deciduous forest (Champion et al. 1965; Feeroz and Islam 2000; Ahsan 2001), where tall trees are deciduous and the understorey is evergreen (Ahsan 2001). NACOM (2004) recorded around 167 plant species and 276 animal species in the park. Two flagship species, the Hoolock gibbon (*Hylobates hoolock*) and the capped langur (*Trachypithecus pileatus*) are found in the park (NSP 2006).

Sampling and data collection

Altogether, there were 14 villages, of which two recognized Forest Villages (locally known as *punji*), Magurchara *Punji* and Lawachara *Punji* were inhabited by members of the Khasia indigenous community and were located within the park. All other villages were located outside the park boundary but all were stakeholders in the forest and the PA (CNRS 2000). Each forest village had a chief, locally known as *Mantri* (minister), who looked after the interests of his community and maintained close liaison with FD. He was much respected and the villagers abide by his commands. As both *punjies* were located within LNP, they were selected for our research to investigate the livelihood dependency of Khasia communities on traditional forest-based hill farming practices in the PA.

In each studied village, a preliminary socio-economic survey was conducted to estimate and categorize the annual income of every household:

Category 1: Poor (income per annum \leq US\$ 1600);

Category 2: Medium ($>$ US\$ 1,600 \leq US\$ 2500);

Category 3: Rich ($>$ US\$ 2500)

Magurchara *Punji* consisted of 40 households (Rich: 11, Medium: 15 and Poor: 14) and Lawachara *Punji* consisted of 28 households¹ (Rich: 08, Medium: 11 and Poor: 09). In each vil-

lage, the proportion of poor, medium and rich households was more or less the same. Moreover, eight was the lowest number of households assigned to the Rich category in Lawachara village. Therefore, we took 8 households as the sample size for each category².

Eight households were selected at random from lists of the households in each category in each of the two villages, 24 households per village and 48 households in aggregate. Before starting household surveys, a discussion was held at the respective local union council offices with the Chairman and members, the village headman (*mantri*) and other influential persons. The discussion helped to explain the work and to get support from villagers. A forestry graduate from the local indigenous community was appointed as an interviewer and interpreter having some basic knowledge of rural appraisal methods.

A semi-structured and pre-tested questionnaire was used to collect both quantitative and qualitative data on socio-economic attributes (household composition, occupation, income and income source) of each household. The head of each sample household was interviewed. Farms were visited to determine their overall condition. To calculate a household's level of forest dependency, we calculated the contribution of forest resources to household annual cash income, i.e., the direct cash derived from selling of forest products, and the cash value of products consumed from the forest, in which would have otherwise been purchased from the market. Few could quantify the production and amount sold, but they knew the income received from the sale of the products. We led a group discussion with the farmers in each village to explore the management of their farms, gender roles in farming activities, attitudes on the future of this farming system and the problems villagers faced. We used a semi-structured questionnaire to facilitate the discussion. A formal discussion was also conducted with officials of the Sylhet Forest Division (**Box-1: F&G**) to ascertain their views about the prevailing practices and their impacts on forest conservation. We conducted informal conversations and brief interviews (**Box-1**) with people from the selected households to get information on villager perceptions of PA management. We recorded the number of trees by species around the homestead of each respondent. Each selected farm area was sampled randomly taking one 10 x 10 m quadrat from the crest, one from the middle and one from the foot of the hill, and the number of trees of each species was collected for each sample quadrat. Data were processed using SPSS.

some of the original villagers invited their relatives to the Lawachara village to build houses and establish betel leaf farms (Saha and Azam 2004). Nath and Inoue (2009) also reported that some of the registered forest villagers had expanded their holdings illegally, some purchased from others, and some inherited land from their kin without the consent of FD officials.

² Nath et al. (2003) conducted a study with the Khasia communities selecting 8 households randomly in each category in each of three villages in Sylhet region. On the other hand, Saha and Azam (2004, 2005) conducted studies in Magurchara village in LNP by sampling 20 households out of 40.

¹ Officially Lawachara village consisted of 23 registered households. But, when we conducted our survey, a total of 28 households were identified. It is may be due to the absence of proper village records and demarcation,

Box-1. Questions presented to respondents to assess their perceptions of the PA:

Questions to the Khasia people:

- A. What monetary benefit are you getting from betel leaf farming?
- B. What kind of problems are you facing from the PA?
- C. Does the park management affect the traditional betel leaf farming system?
- D. How do you consider the park management in LNP?
- E. Why and how do you conserve the PA?

Questions to park authorities (FD officials):

- F. Is there any impact of betel leaf farming on conservation in LNP?
- G. How do the Khasia people contribute to the aims of the FD?

Results

Demography

The total population of the 48 sampled households was 341. Household size varied from 3 to 14, averaging just over 7 members with a male-female ratio of 1:0.9. The male and female literacy rates were estimated to be 43% and 35%, respectively, giving a figure of 39% for the population as a whole; 61% of the population was illiterate; while 24% had primary education only 10% went on to secondary school and fewer still to higher education (Table 1). Education at primary level amongst females was higher than for males, possibly due to the programs “Food for education”, “Tuition free education for female” and “Stipend programme for female” provided by the government to accelerate female education throughout the country.

The principal occupation of the Khasia people, irrespective of their household wealth category, was betel leaf and betel nut cultivation. All sampled households practiced this type of farming in their home gardens and on their allotments of forest-land. Farmers who had substantial lands on the plain outside the forest engaged in agriculture, and others were engaged in service occupations or had additional businesses as secondary occupations. A few farmers reared livestock, but this was of minor importance.

Table 1: Basic Socio-economic and demographic features of the respondents

	Socio-economic and demographic parameters	Relative Frequency (%)
Gender	Male	52
	Female	48
	Sex ratio	1:0.9
Age Class	<15	22
	≥15<30	44
	≥30<45	20
	≥45<60	10
	≥60	4
Education	Illiterate	61.79
	Primary	23.78
	Secondary	9.76
	Higher Secondary	3.46
	Graduation	1.21
Primary occupation	Betel leaf and betel nut farming	100
Secondary occupation	Service	29.17
	Business	25
	Agriculture	25
	Others	4.17
	None	16.66
Average annual income (US\$)	Total	2069
	Primary	1477
	Secondary	592

Income profile and pattern of forest resource use

The interviewers tried to collect precise quantitative data on income and production, but failed to obtain such data as farmers did not keep any records but could recall how much money they received from the sale of different products. The mean annual income of the farmers ranged from US\$ 1515 to US\$ 2773 (Table 2: 1 US\$ = BDT 72). More than 82% of the income of the poorer farmers came from betel leaf and betel nut cultivation compared to 76% and 63%, respectively, for the medium and rich farmer categories. The rich farmers derived up to 15% of their income from other sources and businesses. Although the areas of the betel leaf gardens were the same, incomes from betel leaf cultivation differed due to variation in inputs such as labor, organic fertilizer (manure) and irrigation.

Table 2: Mean annual incomes (US\$) of the Khasia and their sources in Lawachara National Park

Category	Mean annual income (US\$) from different sources						Mean annual income (US\$)
	Betel leaf and betel nut	Trees	Service	Agriculture	Livestock	Business and others	
Poor	1246.00	209.00	37.50	-	7.00	15.00	1515.00
Medium	1452.00	188.00	137.00	-	18.00	125.00	1920.00
Rich	1734.00	179.00	338.00	44.00	61.00	417.00	2773.00
Mean	1477.00	192.00	169.00	44.00	29.00	186.00	2069.00
Percentage	71	9	8	2	1	9	100

The Khasia occasionally and sometimes seasonally collected timber, fuelwood, bamboo, cane, building material (mud), honey,

fruits, vegetables, sungrass, tree bark, medicinal plants and wildlife from LNP. Forest products were collected only for their own

consumption; they had no intention to sell these in the market. On average, about 14% of the incomes of the poorer farmers came from forest products followed by 10% and 6% for medium and rich farmers, respectively (Fig. 1).

Ninety-six percent of poor farmer income was derived from betel leaf and betel nut farming, and forest trees. The corresponding figures were 86% and 69% for medium and rich farmers, respectively: Khasia livelihoods and economy were almost entirely dependent on betel leaf agroforestry.

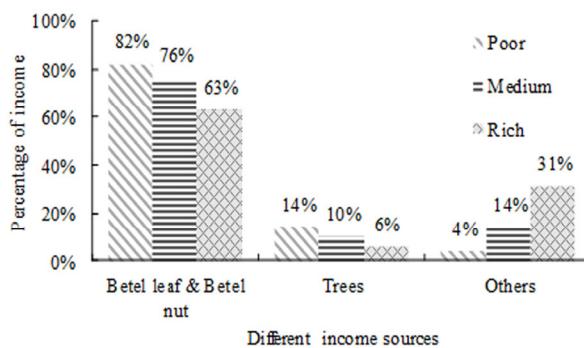


Fig. 1: Contribution of different sources (%) in household income

Forest types and vegetation

The forests of LNP were composed of mixed tropical evergreen and semi-evergreen plant species. The vegetation was both natural and man-made. The old plantations were of primarily native species, mainly *Tectona grandis*, *Dipterocarpus* spp., *Shorea robusta*, *Lagerstroemia speciosa*, *Artocarpus chaplasha*, which had developed a multi-storied structure, including regrowth of creepers and naturally occurring trees and undergrowth species. Sungrass (*Imperata cylindrica*) occurred in pure stands and elsewhere as patches.

The forest on the farms was rich in species with a distinct storied structure. Sixty-one plant species were recorded on the sample farms. Overall functional grouping of species indicated a high proportion of medicinal plants (36%) followed by the food and fruit producing species (21%), timber species (16%), fuel wood species (12%), non-timber forest product (NTFP) species and spices (12%), and ornamental species (3%), respectively. The canopy height varied from 10–30 m. The top canopy comprised both evergreen and deciduous trees, *Tectona* spp., *Artocarpus chaplasha*, *Tetrameles nudiflora*, *Hopea odorata*, *Toona ciliata*, and *Pygenum* spp.. The second canopy comprised *Quercus* spp., *Syzygium* spp., *Gmelina* spp., *Dillenia* spp., *Grewia* spp., and *Ficus* spp. The understory included *Bambusa* spp., *Alsophila* spp., *Geodorum* spp., and *Eupatorium odoratum*, and various ferns and epiphytes.

Hill farming practices and sustainability

Betel leaf and betel nut cultivation were the major sources of income among Khasia people. They cultivated the betel vine on the trees surrounding their *punjis*. The betel leaf garden was called *Jhum* by the Khasia people. In each of the *Jhum*, a number

of commonly used support trees were identified for the betel vines: *Artocarpus chaplasha*, *Lagerstroemia flosreginae*, *Anthoclephalus chinensis*, *Vitex* spp., *Syzygium cumini*, *Cedrela toona*, *Amoora wallichii*, *Salmalia malabarica*, *Schima wallichii*, *Syzygium grandi*, *Eugenia* spp., and *Ficus racemosa*. Farmers always maintained seedlings of different age-groups to use as support trees in future. Although they lived on the forest land allotted by the Forest Department, they did not fell the forest trees but rather conserved them as support trees for betel leaf climbers. They only pruned branches for use as fuelwood.

Most of the Khasia people reported that their farms were sanctuaries for birds and snakes, squirrels (*Ratufa indica*), wild boar (*Sus scrofa*), primates (*Macaca leonina*, *Macaca mulatta*, *Macaca assamensis*, *Presbytis pileatus*, *Hylobates hoolock*), jungle cat (*Felis chaus*), jackals (*Canis aureus*), porcupines (*Hystrix brachyura*), leopard (*Felis pardus*), elephant (*Elephas maximus*), sambar (*Cervus unicolor*) and barking deer (*Muntiacus muntjak*). This indicated that betel leaf based indigenous farming practice by the Khasia people was supportive to biodiversity conservation in LNP.

Both male and female family members participated in betel leaf cultivation. Males were usually engaged in the laborious works, e.g., pit digging, weeding, preparing seed beds, and plucking of betel leaf. Females were engaged in light works like mulching, binding and packing the betel leaf. Children normally participated in sorting and packing the betel leaves.

The forest trees on farms were used as support trees for climbers. Farmers also planted betel nut trees in areas lacking natural support trees within their farms. Betel nut trees are preferable to them as they grow straight, provide partial shade and have a small crown that requires no tending. The betel nuts also provide a small amount of income to them. By transplanting betel nut seedlings and other trees every year, a regular age gradation was maintained in support trees that could be used year after year. Farmers reported that as the coming saplings were used as support trees of new betel leaf cuttings, the system provided sustainable production. Furthermore, when the productivity of old vine declined, farmers planted new cuttings near the base of old vines. As a result, a regular production of betel leaf was maintained.

Decomposed weeds, and lops and tops of pruned materials were used as organic fertilizer. The Khasia argued that these organic materials maintained and to some extent increased soil fertility and moisture. Moreover, the farmers felt that due to the application of biological manure, there was no chance of soil toxicity as might happen after application of inorganic fertilizer. As a result, productivity remained stable.

The Khasia believed that unlimited exploitation of forest resources might affect their future livelihoods. This belief was reflected in the subsistence nature of their forest produce collection. They only collected enough to meet their consumption needs. They did not extract any forest product other than betel leaf and betel nut for commercial purposes. They advised that they conserved LNP because it played a vital role in providing them with their livelihoods and financial security. Therefore, betel leaf based indigenous farming was a great approach for the

sustainable use of forest resources as well as biodiversity conservation within this PA. This indigenous farming system was important not only for villager lives and livelihoods but also for their eternal lives because during their funeral, the priest recited: "Good bye, good bye, you will chew betel leaf in the Kingdom of God" (Banglapedia 2008).

Traditional forest conservation mechanism

Some traditional beliefs in farm management and forest conservation

Farmers reported some of their traditional beliefs, taboos and rituals about farm management and forest conservation. The Khasia believed that dancing at their farm before planting would enhance crop production. The higher the dancers skip, the higher the yields would be. The bodies of deceased Khasia people were cremated and the ashes kept in earthen pots inside houses. When planting new crops, the Khasia buried the ashes in the crop fields with a belief that if the soul of the dead enters the crop field, fertility increases and crops grow well. The Khasia believed betel leaf gardens to be sacred places. Farmers bathed before entering their farms and harvesting betel leaves in the belief that all evil things would be washed away and their garden would be free from pests and diseases. Whenever a diseased leaf or branch touched their bodies, they immediately took a bath so that the disease could not spread. The Khasia felt hurt if outsiders entered their farms without bathing because this could introduce pests and diseases to their *Jhums*.

The Khasia could recognize some pests and diseases that damaged the betel nut palms and betel leaves. For example, a stem borer cuts a tunnel from the root upward, gradually reaching the growing tip, which ultimately breaks off in the wind. Farmers could do nothing to prevent this disease. Another problem was rotting and shedding of immature nuts in the rainy seasons. To overcome this problem, farmers covered the nuts with the basal sheaths of big leaves to protect them from the rain and reduce the damage. Farmers also reported that betel leaves were infected by a disease locally known as *utram* that occurred during periods of high rainfall and high humidity. At first a spot developed on leaves and infected leaves began to dry. Ultimately, the whole vine became infected and died. In severe outbreaks of this disease, farmers uprooted all betel vines on their farms, buried them under soil and kept the land vacant for one year before replanting. They usually tried to apply their indigenous knowledge to eradicate pests and diseases without using pesticides. They believed man-made treatments to be harmful for nature.

There is a folk tale among the Khasia people that God created 16 families. They used to live with God. There was a hill named "Sohpat-Baneng" in the center of the earth. This was the navel of Heaven. A tree was grown from the navel, with which those 16 families used to communicate from earth to heaven. One day, when seven women of the sixteen families came to earth, an evil spirit cut the tree. Therefore, those seven women did not return to heaven. The remaining nine women lived in heaven and those seven women could not communicate with heaven and the direct link with God had been cut off. Based on this religious belief, the Khasia people do not destroy the forest beyond their necessities.

They also have beliefs and taboos that big trees have strong spirits and as such they do not cut them. Some also worship these trees.

Ethno-botanical knowledge

Twenty-seven medicinal plant species were recorded on the farms of the Khasia communities, all of which were commonly used by villagers as remedies for various diseases. Among these 27 species, 14 were trees, 5 shrubs, 5 herbs, 1 palm and 2 were vines. Villagers possessed a rich heritage of knowledge of traditional herbal medicinal in primary health care in their daily lives. Moreover, because they lived in remote forest areas, they depended on those medicinal plants for medical treatment. The Khasia people reported that they plant and tend various herbs and shrubs in their homesteads. They utilized these plants both for religious and medicinal purposes. The Khasia usually do not rear livestock. They believed that livestock may damage plants in their home gardens as well as in the hill farms. In this way, they conserve plants in and around their home gardens. In addition, the traditional betel leaf based hill farming practices play an important role in the conservation of plants that have medicinal uses.

Perception towards protected area management

The attitudes of local communities towards PAs are increasingly being considered in the establishment and management of national parks. Most of the park authorities reported that the Khasia people played a vital role not only in plantation establishment and protection but also in forest conservation. Their traditional farming system did not conflict with the objective of LNP. The Khasia people conserved the forest for their self-interest. They pruned trees every year to create enough space for light penetration. Maintaining an age gradation of support trees, played an important role in sustainable production by the farming system and the conservation of the tree cover on the land.

Most households expressed positive attitudes to LNP. They consider it the life-blood of their existence and a potential source of income. Therefore, forest based betel leaf farming system has had positive impacts on the conservation or preservation of LNP. A few of the respondents also expressed negative attitudes due to problems associated with land tenure, marketing of products, damage-causing animals, misbehavior of the park authorities, including inadequate maintenance of LNP and lack of compensation for affected farmers. Because the Khasia people did not have permanent rights to use their allotted lands, they were susceptible to harassment to force them to leave their allotments. Moreover, many of the Khasia people were gradually becoming richer and they expressed reluctance to work in the forest plantations, which was a breach of their contracts with the FD.

Discussion

Although the PA declaration does not allow any type of cultivation practices within the PA, in case of LNP, the Khasia commu-

nities were settled there prior to PA designation to support the FD plantation program. Betel leaf and betel nut farming on forest lands was the principal source of livelihoods of the Khasia community. The respondents received most of their mean annual income from this farming irrespective of their financial status. Nath et al. (2003) found that the mean monthly income of Khasia people was almost three times higher than the average per capita national income of Bangladesh, whereas, Shah and Azam (2004) reported it seven times higher. On average, about 14% of the poorer farmers' income came from NTFPs followed by 10% and 6% for medium and rich farmers, respectively. In comparison, Arnold and Perez (2001) found that in most tropical countries, NTFPs played a significant role in the livelihoods of a large section of the poor living within or near forests. Senarate et al. (2003) concluded that NTFPs played a marginal role in fulfilling the daily needs of rich households.

The rich farmers reported that they could save a portion of their income and invest it in purchasing of new farms or agricultural lands outside the forest area. Alam et al. (1993) also reported that some Khasia villagers could save a substantial portion of their betel leaf income that they later invest in purchase of agricultural lands. As a result, a small amount of rich farmer's income (2%) came from agriculture. Since betel leaves are typically collected almost year-round, villagers have consistent cash flow throughout the year. Moreover, this farming system generates employment opportunities for other forest dwellers and unemployed people living near forests in farm activities such as land preparation, weeding, pruning, mulching, plucking, binding and packing of betel leaf. In Central Africa, forest communities generate 67% of their total income from hunting and gathering, and only 33% from agriculture, labor and employment, which illustrates how vulnerable forest communities can be to changes in forest access (Cernea and Schmidt-Soltau 2006).

Since the Khasia people were allotted the same amount of forest land by the FD to cultivate betel leaf and betel nut, we tried to explore the causes for the income differential between farmers of betel leaf versus betel nuts. Betel leaf cultivation requires inputs of labor, organic fertilizer and irrigation. It is a labor-intensive farming system and often family labor is not sufficient for farm management. Many households depended, therefore, on hired labor (for cleaning, mulching, pruning, planting, plucking, processing, and watering). Poor farmers were often incapable of hiring laborers and this ultimately affected farm yields and income. The power structure of the community was also an important factor, meaning that the *Jhums* belonging to richer households were located in more suitable sites for cultivation of betel vines. The FD allocated the most suitable sites to the powerful farmers. Besides, the Khasia people who were rehabilitated at the first stage were allocated the most suitable sites for cultivation. Due to the remoteness (in terms of distance from water bodies, slope and height of the hills) of many *Jhums*, it was not possible to provide sufficient irrigation to the farms and this led to decreased production. Nath et al. (2003) and Riadh (2007) reported that site location also affected farm yields. Market access was a major problem for betel leaf cultivation (Nath et al. 2003, 2009; Saha and Azam 2004 and 2005). Middlemen played a significant role

in betel leaf marketing. They normally made 25% to 30% profit margin. Due to lack of credit facilities from the government, the poor farmers were sometimes forced to take credit support from the middlemen and this restricted farmers' bargaining power and reduced the prices they received from the sale of betel leaves. Saha and Azam (2004) also found that the benefits of high market prices went to the middlemen rather the betel leaf farmers.

The level and extent of forest resource use by local communities is an important issue for biodiversity conservation in PAs. The sustainability of hill farming has become a serious global concern as increased population intensifies the pressures on land and forest resources to meet villager livelihoods (Friedrich 1994). Nath et al. (2003) reported that sustainability could be indicated by: maintenance or increase in soil fertility; stable or increasing yields; and maintenance of a regular set of age-classes for sustainable production. Since the Khasia people collected forest products for domestic consumption rather than for commercial sale, their extraction pattern of forest resources was relatively sustainable. Besides, secure markets and maintaining a different age-class of support trees play an important role in the sustainable production of the betel leaf based hill farming system and the conservation of the tree cover on the land. Saha and Azam (2004) argued that betel leaf forest farming is a sustainable hill-farming system, contributing to replenishment of the forest reserves, protection of timber plantations, and protection and conservation of biodiversity of the surrounding reserved forests. Alam and Mohiuddin (1995), Nath and Inoue (2009) and Rahman et al. (2009) showed that forest based betel leaf farming system is a good mode of *in-situ* conservation of tree diversity.

In the Chittagong Hill Tracts of Bangladesh, shifting cultivation is practiced in the hills by tribal people. In contrast, the Khasia indigenous communities did not practice this type of cultivation in the Sylhet region. In shifting cultivation, farmers prepare land by cutting jungle, drying timber residues and then burning. Unburned debris is collected and the roots of previous crops are dug out. This farming system affects the ecosystem of the area by destroying biodiversity. It accelerates soil erosion, burning produces smoke and increases greenhouse gases in the atmosphere (Myers 1989). On the other hand, the betel leaf hill farming of the Khasia people is a more environmentally friendly system. It has been reported (Nath et al. 2003; Saha and Azam 2005) that the Khasia are conserving the biodiversity of the LNP, maintaining their livelihoods in a sustainable way and playing a vital role in LNP management. Therefore, the cultural and agricultural traditions of the Khasia have great effects on the management of natural resources in this region. Moreover, their reciprocal contribution to forest plantation and day-night patrolling of forests help to conserve forest resources in LNP (Nath and Inoue 2008). Although the PA designation did not permit any type of cultivation practice within the PA, the government policy of rehabilitation of Khasia for conserving biodiversity in LNP has improved land-use efficiency (Saha and Azam 2004).

The myths, rituals and beliefs of the Khasia people were one of the major factors for conservation of plant resources on their farms. The taboos, religious beliefs and folklore have protected plants including medicinal plants (Jeeva et al. 2006) and pre-

cluded collection of raw materials from their betel leaf gardens. Local technologies (Gandhi 1982) and local knowledge systems such as ethno-forestry (Pandey 1998) have an important role to play in biodiversity conservation and sustainability.

Forest based betel leaf cultivation can be adapted to other hill forests of Bangladesh with climatic and edaphic conditions similar to those at LNP. The concept of forest villagers has long been established not only in Bangladesh but also other neighboring countries. They live within the forest area but have no right to practice farming on lands they occupy. They have no alternative sources of income other than daily labor wages paid by the FD. If they practiced a suitable cropping system involving the conservation of forest trees, this might protect the forest (Nath et al. 2003). Due to poor socio-economic condition their attitudes towards forest conservation are typically negative (Sarker and Røskaft 2011). Sometimes this encourages outsiders to illegally extract forest resources. Senarate et al. (2003) and Riadh (2007) reported that alternative income-earning opportunities (like betel leaf cultivation in LNP) substantially reduced dependency on forest resources, particularly on non-timber forest products (NTFPs).

Conclusion

Lawachara National Park is a significant source of income for Khasia communities that depend on betel leaf farming in LNP. As a result, LNP has become the life-blood of Khasia survival. This traditional farming system can be seen as supportive of PA management since it provides social security, regular economic benefits and livelihood support for Khasia people without posing any large threat to natural resource management in the LNP. If people can realize sustainable benefits, they will find it in their own interests to maintain the production system whether it is forestry, agriculture, or any other kind of development intervention (Nath and Inoue 2009). Therefore, the protected area management strategies must highlight the livelihood dependency of local communities. Economic benefits can be increased and ecological balance can be maintained by improving the existing management system through government initiatives such as funding for research and development, policy intervention into sharing of benefits obtained from LNP among stakeholders, and integration of suitable high-value tree species. If the problems of land tenure, availability of planting materials, pests and diseases, marketing of products, and transport can be resolved, this traditional forest based betel leaf hill farming practice might be a model for sustainable management of protected areas not only in Bangladesh (especially where shifting cultivation is a serious “threat” to forest and environment) but also in other countries. Potential for extension of the system to other areas with similar conditions should be investigated.

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